EXAMINATION OF THE CONSTRUCTABILITY REVIEW IN GOVERNMENT CONTRACTING

Contract N66314-70-A-0086
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CIVIL ENGINEERING 697

AUGUST 3, 1984

Introduction

The United States Navy, through the Naval Facilities Engineering Command, annually awards billions of dollars in design and construction contracts. These contracts cover a wide variety of projects from highly technical designs, unique to the military and requiring extensive, complex, plans and specifications, to common maintenance/rehabilitation projects requiring a much simpler contract design package. Regardless of the type or complexity of these projects however, they all have one thing in common. They all must undergo an extensive, detailed design review process that must be completed on each contract before it may be advertised for bid.

The overall review process is accomplished in several stages, from the initial concept stage, to the preliminary (30%) stage, to the 90%/100% stage, to the final review prior to publication. The specific review may be highly technical in nature, as performed by the engineering personnel at the appropriate Field Division Office. It may be a maintainability review as performed by the user and/or the Public Works Office responsible for the completed project. Or it may be a constructability review, as performed by the Resident Officer in Charge of Construction (ROICC) responsible for the administration of the construction contract following the award. The relationship between the type of review performed, the sequence or stage in the design process and the agency performing the review is illustrated in Table 1.

DESIGN REVIEW PROCESS

STAGE	A/E	CUSTOMER	PWO/SCE	OICC
1. Concept		1. Identify needs; Specialty Criteria 2. Identify collateral equipment requirements	1. Verify needs 2. Refine project scope	1. Oversee A/E selection 2. Provide A/E with design criteria
2. Preliminary (10 - 30%)	Submit: Outline Specifications; Preliminary Drawings; Basis of Design; Soil Report; Preliminary Cost Estimate	1. Confirm satisfaction of operational requirements; 2. Check layout and size 3. Finalize collateral equipment requirements	1. Conformity with station master plan 2. Check energy/environmental needs	1. Check design; 2. Look for unusual methods or requirements
3. 90%/100%	Submit: Working drawings; Specifications; Cost Estimate; Calculations; Color & Sample Boards	1. Check surface finishes and colors 2. Sign drawings (satisfactory approval)	Check maintainability	1. Route to ROICC for for comment (CRITICAL) 2. Check estimate; design; Division 1 clauses requirements; bid items
4. Final	Submit: Final Working Drawings; Master Specification; Final Cost; "DD" Forms; Calculations; Color Samples			Check for completeness of paperwork; Administrative matters 1. Prepare final Gov't estimate for contractor work

(Table 1)

Each specific type of review and individual stage of the total review process has the potential benefit for overall improvement in the final project. The constructability review however, encompassing as it does a review of the total design package rather than a single aspect, would seem to have a greater potential to consistantly improve the design package on almost any type of project. It is this latter type of review that will be the subject of examination by this paper.

Definition

"Constructability is defined, for the purposes of the Navy, as "the practicability and correctness of a project design, including the inherent capability of the contract documents to be understood, bid, administered, and enforced". The policy of the Naval Facilities Engineering Command is that a constructability type of review must be conducted to assure that the project design is compatible with the project site, site conditions, and available construction materials and methods. In addition, this review should also assure that the contract drawings and specifications do not contain significant design errors, omissions and/or ambiguities.

Cost Benefits

With very few exceptions, Government construction contracts are advertised, bid, and awarded to the lowest responsive, responsible bidder. As may be expected from contracts of this

type, once awarded there is little or no flexability to make adjustments to the contract documents in response to coordination errors without allowing for the potential payment of additional compensation to the contractor. Any such required adjustment (or Change Order) becomes, in effect, a seperate, sole source agreement, lacking in the competitive atmosphere present during the contract award and significantly impacting the ability of the Government to assure the best (or lowest) cost for the work. Although the contractor has no option but to perform any and all work as directed by the Contracting Officer, he is given the guarantee of "equitable" adjustments in the contract price as compensation for such work. In subsequent negotiations of this type, experience has shown the advantage often lies with the contractor. The constructability or coordination type of review has proven to be an effective tool in reducing the number of coordination errors prior to advertisement, thus assuring proper competition and competitive prices for the construction work, as well as in somewhat reducing potential rework costs.

Direct cost benefits that may be derived as a result of the constructability review process are, to some extent, measureable and therefore provide the most visible justification for the allocation of both time and money for the performance of the review process.

Although not as readily apparent, there are indirect cost benefits that may also be obtainable through the review process. Unfortunately, such benefits are extremely difficult if not

impossible to accurately quantify and are often ignored as insignificant. Inaccuracies or inconsistancies in the contract documents that require some type of clarification but which do not result in any change in the direct cost elements, may nevertheless require a significant expenditure in both the time and the effort of management personnel. While it is argued that this does not change the overall cost of construction, as the salaries of these individuals are usually fixed and as such, already included in the budget as overhead expenses; it should be recognized that any time "spent" by management in resolving conflicts that could reasonably have been caught prior to award, is time that might be more efficiently and effectively utilized on other related contract activities.

Time Element

The ideal result of any effective review program is the elimination of all non-elective Change Orders and thus greatly simplifying the construction process. However, it would be naive to believe that any construction contract will run its course without some Change Orders and one cannot reasonably expect any set of contract documents to be perfect. Perfection is no more possible in the field of design than elsewhere and its pursuit beyond a certain point becomes inefficient.

In any activity of this type, decreasing returns set in after a period of time. Theoretically, there is an optimum point beyond which further expenditure of time is no longer effective.

However, when both direct and indirect benefits are considered, time may be expended in contract review for very small proportional reductions in combined costs yet still prove worthwhile. After all, an error need not be dramatic in size or scope in order to lead to significant confusion and a resulting increase in administrative expense. Even a seemingly small and unimportant detail may prove to be the cause of a serious dispute.

An accurate prediction of the amount of time required to complete an adequate constructability review is difficult at best and will vary significantly from one project to another, depending upon the complexity of the project, the experience and expertise of the reviewer, and the effort of the A/E in conducting his own coordination review prior to subsequent review by Government personnel.

Purpose of the Analysis

As previously stated, the purpose of this paper is to examine the constructability review in construction contracting by the U. S. Navy. To accomplish this, a recently completed construction contract was chosen as typifying the general type of construction projects that might normally be encountered in the Navy's construction contracting program. By examining the amount of time that was used in the preparation of the original constructability review and the review comments that were made, then by developing a figure representing the cost benefit that was derived from this review, it should be possible to provide some

measure of the cost effectiveness of this specific review.

The next stage of the analysis is to conduct a second constructability review. This review will be performed on the contract documents as they were advertised and bid. By examining the time spent on this subsequent review and deriving a resulting figure representing the cost benefit, one should be able to develop some measure of the efficiency of the original review and to provide an indication as to whether or not additional emphasis (time) on contract review beyond that given to a typical construction contract, should also prove cost effective.

The final stage of the analysis will be to examine the constructability review process as a system. Combining the "ideal situation" results from the cost analysis with "real world" conditions should result in some observations regarding potential improvement in the overall efficiency of such reviews.

Project Data

The project chosen involved the construction of a 12,000 SF cold storage warehouse, including 1,800 SF of attached office spaces. The General Description of the work as quoted from the bidding documents is as follows:

> "The work includes the relocation of existing underground high temperature water distribution lines; and the provision of a metal frame building on concrete slab and foundation walls, insulation, metal flashing, HM units; metal doors,

panels and windows, built-up roofing on metal deck, gypsum board, tile work, accoustical ceilings, glazing, fire alarm and detecting system, woodwork, bath accessories, painting, interior and exterior lighting, transformers, hot water heating, refrigeration and air systems and sprinkler systems, loading dock equipment, ductboard and order picking vehicles. The work also includes asphalt and concrete paving, sodding and incidental related work".

This project was advertised in the $2,500,000 - $5,000,000 range and was initially awarded for $1,849,000. The contract was amended by three Change Orders and was completed at an approximate cost of $1,891,000. This final cost is only an approximation due to a minor dispute that is as yet unsettled, however, as it does not involve either the plans or specifications its lack of resolution should not materially affect this analysis.

The Original Review

Of the 51 items noted in the original constructability review as performed at the 90%/100% stage, (and taking into account the replies to those comments) 27 have no effect on either direct or indirect costs. Of the remaining 24 items, 13 have little potential for any direct cost implications, but should have indirect costing implications. The remaining 11 items have both direct and indirect cost implications. These original review comments, as well as the replies to those comments (as made by both the A/E and the Engineer-in-Charge of the design

stage) are included as Appendix I. In order to obtain a reasonable estimate of the cost benefit obtained as a result of this review, the potential costs were divided into two categories; direct costs and indirect costs. The comments included in Appendix I have been annotated to indicate which items were identified with which grouping.

Direct costs are normally reasonably easy to estimate, using any of several accepted material take-off methods. This was done for each review item having direct cost implications. The direct costs were then totaled and factors were added for field office overhead, home office overhead, profit, and bonding. For simplicity and also to maintain a conservative basis for the estimate, it was assumed that all work would be performed by the prime contractor. A complete breakdown of this estimate is included as Appendix II, along with a summary supplying the rational behind the cost factors established for each item.

The cost figure derived from this estimate is not totally applicable as a cost benefit resulting uniquely from this review. The figure developed is actually an estimate of what the cost for those items might have been had the review not taken place and the contract adjustments and additional work required by these items accomplished as formal Change Orders to the contract. Any direct cost benefit that may truely be considered to have been gained through this review process would be that price difference between this estimated "Change Order" cost and the cost for these same adjustments and work performed under the competitive bidding

process. This difference is not easy to accurately determine and is dependent upon the current economic climate within the construction industry and the disparity between the specific contractor's normal practice of marking up direct costs in bidding and the standard government allowable mark-up of approximately 21% used in the negotiation of change orders. Estimates by the government place this difference as high as 10% or as low as 2% , depending upon the current conditions. Using these figures result in an estimated range of the potential cost savings for this project due to the performance of the review of from $6,175.94 to $1,235.19.

Estimates involving indirect costs, as noted previously, are very subjective in nature and therefore much more difficult to justify. For the purposes of this analysis, those review items with indirect cost implications were examined individually and estimates of the time that could reasonably have been "spent" by Government personnel in providing appropriate clarification/solutions. For simplification, this time estimate was sub-divided into only two paygrades; the first, that of Lieutenant (O-3) representing the individual responsible for the administration of the construction contract, and the second, that of Contract Specialist (GS-5) representing the person responsible for maintaining the contract records. This item by item estimate of the use of time is based upon the author's work experience in similar situations and with the basic assumption that the items noted would not normally result in any significant contract

dispute or claim. A detailed breakdown of this estimate of the indirect cost savings is included as Appendix III.

It may be argued that this indirect "cost" estimate should be reduced by some factor, as it is in reality, only an estimate of the potential for increasing the future efficiency of the contract administrative personnel and not in effect, a true "cost" savings. While it may be true that any resulting increase in overall efficiency due to the performance of such a review cannot reasonably be expected to be 100% effective, it is felt that the subjective (and conservative) nature of the estimate, as well as the assumptions made for simplicity, tend to balance out any related efficiency correction and that no adjustment is necessary. The purpose of this analysis is, after all, to examine the potential for cost savings through the constructability review and not an attempt to establish absolute relationships. Therefore, based on this estimate, the indirect cost benefit directly resulting from this review is approximately $329.01.

In calculating a similar time "cost" for the review itself, it was again assumed, for simplicity, that the total review was performed through the efforts of only two paygrades. The Lieutenant (O-3) who performed the actual review, and the Contract Specialist (GS-5) who provided a minimum amount of clerical assistance. This "cost" estimate was based on 18 hours of review time (based on information from the officer that actually performed the review) and 1 hour of clerical time, or approximately $229.27.

Combining the indirect and direct cost figures and comparing them with the "cost" of the original review, results in a rate of return on "investment" of from 28.4 to 6.8 times, depending of course on the direct cost benefit figure used. Further analysis indicates a corresponding reduction in the change order rate of from 5.8% without the review to 2.3% as the project was finally completed. Calculations for these figures are shown in Appendix III.

Subsequent Review Data

The difference between the estimated "cost" of the review itself and the combined direct and indirect cost savings generated as a result of that review, clearly indicates the validity of the cost effectiveness argument for performing constructability reviews. There remains, however, a question as to just what amount of effort constitutes an adequate review. Could more emphasis (i.e. more time spent and therefore a more detailed review) on the review for this project still result in a positive return.

In an attempt to explore this premise, an additional constructability review was performed on the contract documents for this project as it was originally bid. The comments resulting from this review are included as Appendix IV. They have again been annotated to indicate the cost implications of each item.

In estimating the potential cost benefit from this second review, a slightly different method was used than could be

employed on the first set of review comments. As the contract is now substantially completed, the contract files were examined and used as a basis for calculating the potential cost savings produced by this review. Direct costs were simply taken from the records of negotiation for the contract Change Orders that pertained to the review items and indirect costs were developed using the actual correspondence files and information from the officer assigned to the contract. An item by item breakdown of this estimate is included in Appendix IV. Based on this estimate, the direct and indirect cost benefit resulting from this second review varies from $334.31 to $185.67, depending upon the figure used for the direct cost benefit.

The estimate of the "cost" of performing this review was prepared using the same assumptions and methods as before, using 9 1/2 hours of review time and 1/2 hour of clerical assistance as a basis. This results in an estimated "cost" for this second review of $120.80.

Comparing the cost benefit figures with the "cost" of performing this additional review, results in a rate of return on "investment" of from 2.8 to 1.5 times, again depending upon the direct cost figure used. Calculations for these figures are included in Appendix IV. Although these figures are not very large, they again demonstrate the cost effectiveness possible through this type of review and that additional effort, even on a project that received a fairly good 90%/100% constructability review (as evidenced by the relatively small cost savings

generated by the second review) may still result in additional cost benefit.

Constraints

As the previous analysis indicates, there is a demonstratable potential for achieving a significant cost benefit through the performance of a thorough detailed, constructability review. The actual effectiveness of any single review in achieving this benefit however, is dependent upon the total time spent in reviewing the contract documents and on the effective use of that available review time. The latter is dependent upon the experience and expertise of the individual actually performing the review. The often large differences in these later two characteristics noted among those typically assigned to perform constructability reviews have resulted in the development of review guide lines or check-lists to assist in the preparation of such reviews. Two examples of check-lists of this type have been included in Appendix V. These guides serve to provide a minimum quality level for review and assist those reviewers with less experience in reviewing Government contract documents to become more effective.

Although these typical review guides have proven effective in establishing minimum standards, they are not arranged with any attention given the review time that may be available to actually perform the constructability review. Ideally, there should be sufficient time alloted to the review process to enable the

reviewer to complete a thorough and detailed review. In reality however, conflicts with other contracts, project schedules, excessive work loads, etc., often dictate the amount of time that may be made available for the review process. This often leads to incomplete reviews that fail to utilize this available time efficiently. In an effort toward improving the effective use of this review time, a simple system for the review of contract documents called REDICHECK was developed (and copyrighted) by a Navy Civil Engineer Corps Officer. This review guide differs from most similar systems because it is based on the sequence of construction rather than being divided into engineering disciplines. It is a prioritized checking system that enables the reviewer, if following the sequence, to check what have proven to be the most critical items first. As there is obvious merit to an effective systems concept for checking and coordinating construction contract drawings, this system was made available to Navy Construction Contract Offices and since first tested in 1979, has yielded actual savings far above the effort of review. It has shown, on the average, a 1% reduction in overall construction costs and up to a 25% reduction in potential claims.

Conclusions

The constructability review process, as has been demonstrated by this cost analysis, has shown a definite potential in the overall reduction of direct and indirect costs on Naval construction contracts. A significant reduction in the number of

design errors and contract ambiguities, accompanied by a corresponding reduction in the number of non-elective Change Orders, should result in a more efficient contracting system. It should also be remembered that any corrections that may be required due to such errors or ommissions that may be made prior to award are, in general, developed with much less emphasis on haste than normally experienced once construction has begun. Because of this, changes completed as early as possible in the design/construction cycle are less likely to cause confusion and generate additional coordination problems of their own. Further direct cost reductions could also possibly be achieved by such a review system in improving the reputation of Government plans and specifications. Increasing the contracting profession's confidence in the accuracy and completeness of Government contract documents could result in some reduction factor in the mark-up that contractors apply to Government contracts in compensation for the administrative "red tape" associated with the Government's contracting system as a whole.

In addition to the direct cost savings that may be achieved through the effective use of this type of review, there is also a significant potential "savings" in indirect costs as well, through the improvement in the efficient use of administrative time. The elimination of as many potential contract conflicts as possible prior to the start of construction, should improve the quality of the construction contract administrative effort and allow these personnel a greater opportunity to anticipate and

plan rather than operate on a day to day system of crisis management. In today's economic and political climate of tight budgets and continuing pressure toward reductions in Government personnel, "savings" of this type are becoming more and more critical. Without some increase in efficiency or a decrease in the work load (very low probability of the latter) "can do" may soon become "no can do".

Efforts have been made to increase the emphasis on performing effective detailed, contract reviews but, unfortunately the Government's usual method for such motivation, the introduction of a newer more comprehensive (meaning more complicated and with more pages) instructions concerning review policy and proceedures, have had little or no effect. It is essential that too much pre-occupation with "the system" be avoided, lest little by little "the system" of how the review process functions becomes more important than how effective and efficiently it works. The constructability review process should be as simple as possible to avoid adding any negative aspects to the already time consuming, tedious, and often boring job of performing the actual review.

Those who perform the constructability reviews, the engineers and architects are, by their very nature and education, problem solvers not problem detectors. It is much more exciting to rush about making critical decisions, solving problems and keeping 10 or 12 balls in the air at one time, than to spend a week or so trying to de-bug a set of contract documents. These

individuals also often feel uncomfortable reviewing areas outside their own field of expertise. Although the existance and advisability of the constructability review is widely accepted and discussed in texts and in seminars, there is very little information on how to go about performing one. Guidelines and check lists are subsequently developed, but only after having gained significant experience "the hard way".

When such guides or check lists are made available to reviewers, they are generally either comprehensive in nature, designed to fit any possible situation (therefore somewhat confusing to the inexperienced) or simply a list of those areas where problems often occur. In either case, the review tends to be a series of answers to often unrelated questions rather than an analysis of how well the project may go together.

It is felt that by concentrating on the method of construction rather than on lists of potential problem areas and by using some type of systems approach such as offered by the REDICHECK system, more effective contract reviews should be produced and the subsequent savings in time and money realized.

CONSTRUCTABILITY REVIEW COMMENTS

1. 01011-1, Paragraph 4 indicates 270 days (9 months) for completion. Fork lift trucks in 14500-1 take from nine to twelve months to procure. R-26 report of 30 April 1982 projects award June 1982 and CCD December 1983, which is 18 months. Is the completion time realistic? It also conflicts with the R-26.
   [*** This item has direct and indirect implications. ***]

2. 01011-11, Paragraph 18 makes CPM or PERT optional. More beneficial to make it manditory.
   [*** This item has no cost implications. ***]

3. 01400-4, Paragraph 1.4.5 - A test log indicating each specific test called for by the plans and specifications submitted prior to the start of work and maintained throughout the contract would be more beneficial than one compiled before final payment. CQC should give adequate advance notice of tests that will be witnessed by the Government.
   [*** This item has indirect cost implications only. ***]

4. 01560-2, Paragraph 1.3.1 - Environmental Protection Plan deleted?
   [*** This item has no cost implications. ***]

5. 02070-1 - No phasing of demolition and new construction included. Existing cold storage may not be demolished until the new building is completed and ready for use. 01011-1, Paragraph 2 - Does not include demolition work.
   [*** This item has no cost implications. ***]

6. 02102-3, Paragraph 5 - Presently on site is a large quantity of rubble (i.e., telephone poles, fence poles, miscellaneous steel and concrete objects). Does paragraph 5 satisify removal of the rubble?
   [*** This item has direct and indirect implications. ***]

7. 02200-5, Page 13 is not completely marked up. Many paragraphs have questions.
   [*** This item has indirect cost implications only. ***]

8. 02200-10, Paragraph 3.6.2 - Frequency of tests should not only be based on a square foot minimum, but also on a lineal foot basis. Also, a minimum of one test per back-filled area. (Such as at street crossings.)
[*** This item has direct and indirect implications. ***]

9. 02202-14, Paragraph 3.6.4 - Has a decision been reached for pipe installation under tracks?
[*** This item has no cost implications. ***]

10. 02202-16, Paragraph 3.9.4 - Same as No. 9.
[*** This item has no cost implications. ***]

11. 07920-4, Paragraph 3.3.4.2 - Provide sealant under all flashing and drip edges.
[*** This item has no cost implications. ***]

12. 09910-9 - Only half the page is printed.
[*** This item has no cost implications. ***]

13. 15659-2, Paragraph 1.2.1-P - How many Ammonia Vapor Detectors?
[*** This item has direct and indirect implications. ***]

14. 15652-17, Paragraph 3.4.2 - Indicates five ton compressor. On the plans a ten ton unit is indicated.
[*** This item has direct and indirect implications. ***]

15. 15652-32 - Part of the page is missing.
[*** This item has indirect cost implications only. ***]

16. 15652 - End of section occurs on page 42. There are an additional seven pages after end of section which are not marked up.
[*** This item has indirect cost implications only. ***]

17. 15711-26, Paragraph 3.14.7 - Test pressure is indicated as 1.5 times working pressure, but no minimum pressure is required which all pipes must be tested at regardless of their working pressure.
[*** This item has indirect cost implications only. ***]

18. 16302-9, Paragraph 3.12 and 3.15 - Not marked up/no overhead pole mounted transformers indicated on plans.
[*** This item has indirect cost implications only. ***]

19. 16722-9, Paragraph 6.12 - Compatible with base system. Base uses Gamewell and to be compatible, Gamewell must be used.
[*** This item has no cost implications. ***]

20. Transmittal sheet indicates that Section 16011, 16301, and 16462 are part of the transmittal. They were not included with the specification package. Transmittal sheet does not include Section 07230, but it was included with specification package.
[*** This item has no cost implications. ***]

21. Drawing C-1 and T-1 - Foundation shown on C-2 not shown of Southwest corner of site.
[*** This item has indirect cost implications only. ***]

22. Drawing C-2 - Concrete pads on C-1 to be removed not shown on Northwest corner of site.
[*** This item has indirect cost implications only. ***]

23. Concrete slab located approximately 1050 N and 1300 E not shown on any drawings.
[*** This item has indirect cost implications only. ***]

24. C-3 - No blow counts indicated on soil boring log.
[*** This item has no cost implications. ***]

25. Drawing A-1 - Floor drains in rooms 114, 115, 116, and 117 not shown/no elevation.
[*** This item has no cost implications. ***]

26. Slope on roof indicates a plus/minus 1/2" per foot. Shouldn't it be minus 1/2" from peak?
[*** This item has no cost implications. ***]

27. Drawing A-2 - Section 4/A2/A12 not labeled on A-12
[*** This item has indirect cost implications only. ***]

28. Drawing A-4 - Bottom chord of truss not tied into wall.
[*** This item has no cost implications. ***]

29. Drawing A-6 - Details for brick wall do not indicate any flashing. Brick also extends below grade.
[*** This item has no cost implications. ***]

30. Drawing A-10 - Detail 8 indicates ground stabilization fabric not included in specifications.
[*** This item has direct and indirect implications. ***]

31. Drawing A-12 - Details show no vapor barriers between concrete block, precast panels and wood blocks. No caulking indicated under flashing and drip edges. No detail 4/A12/A12 as indicated.
[*** This item has indirect cost implications only. ***]

32. Wood used on the roof is more specific when stated "wolminized" instead of "treated" (A-12), Detail 30 and 16.
[*** This item has no cost implications. ***]

33. On Detail 9 (E-2) there should be a supply fan to coincide with Exhaust fan No. 4.
[*** This item has no cost implications. ***]

34. Doors and dock levelers that are motor controlled should be detailed in order to be a manual run, if needed.
[*** This item has no cost implications. ***]

35. Detail 18 and 9 (E-2) with that much equipment would it be safer with 600A Bus Bar?
[*** This item has no cost implications. ***]

36. Drawing E-4 - Emergency lights are also needed in Lunch Room, Manager's Office and above North Doorway.
[*** This item has no cost implications. ***]

37. Detail 5 (E-6) welding outlets are normally supplied by a 50A or 60A panel independently.
[*** This item has no cost implications. ***]

38. No outside lights are mentioned on the prints.
[*** This item has no cost implications. ***]

39. Detail 18 and 6 (E-8) are better off with a 100A panel when controlling motors.

[*** This item has no cost implications. ***]

40. Details 18 and 6 (E-8) Fuses should be either on the motor or the panel in case all motors flip on at one time.
[*** This item has no cost implications. ***]

41. E-13 - Why not smoke detectors in the Refrigerator Rooms in case the equipment catches on fire?
[*** This item has direct and indirect implications. ***]

42. Wouldn't it be better if Public Address System and telephone jacks were installed during construction?
[*** This item has direct and indirect applications. ***]

43. E-13 - Shouldn't there be a protection horn installed in the egg, vegetable and fruit coolers?
[*** This item has direct and indirect implications. ***]

44. 16302-15, Paragraph 5.2 - No overhead transformer on the plans.
[*** This item has indirect cost implications only. ***]

45. Drawing M-1 - No detail for connection of hydrants to new water meter vault.
[*** This item has no cost implications. ***]

46. 07511-8 - Flashing felt is called for where composition felt is presently considered to be appropriate.
[*** This item has no cost implications. ***]

47. Drawing M-8 - Detail 23 indicated sump pump/no electrical tie-in, not included in specification. Use of drains versus sump pumps have been used successfully in past.
[*** This item has no cost implications. ***]

48. No schedule for CU-1 (10 ton) on drawing M-6 and HVAC No. 1, drawing M-5.
[*** This item has direct and indirect implications. ***]

49. Ammonia plants must have gas masks in areas of ingress before entering affected spaces.
[*** This item has direct and indirect implications. ***]

50. Drawings T-1 and M-1 conflict on the existing HTHWS&R and the new connections.
[*** This item has indirect cost implications only. ***]

51. Electrical General: Electrical section was only given a cursory review. Numerous deficiencies were pointed out to the design manager, D. Wingo. Appears plans and specifications on electrical section are incomplete, D. Wingo has indicated Electrical Design Branch doesn't have time to review until after contract award. Accordingly, all change orders relating to Section 16 will be coded as a "PLAN" change item during the course of construction.
[*** This item has no cost implications. ***]

A/E RESPONSE
to the
CONSTRUCTABILITY REVIEW COMMENTS

The following is a list of the replies made by the A/E to the constructability review comments indicating action taken, answering questions raised, etc. The line numbers used refer to the comment number from the review.

1. Comment response unclear - we do not have R-26 report to determine conflicts in construction schedule.

2. Not required for this small of a project.

3. Corrected.

4. Not warranted.

5. Corrected and completed.

6. Corrected and completed.

7. Comment not specific enough for response.

8. Completed.

9. Refer A/E letter to Northern Division July 23, 1982.

10. Refer A/E letter to Northern Division July 23, 1982.

11. Not recommended - condensation trapped behind flashing and drip edges.

12. Corrected.

13. One detector located in engine room.

14. Corrected - 10 ton unit is being specified.

15. Page does not apply.

16. Completed.

17. Completed 100 PSI.

18. Corrected - no overhead pole transformers required.

19. Cannot mention specific manufacturer - ROICC will have to handle with contractor.

20. Corrected and completed.

21. Added information to sheet C-1.

22. Added information to sheet C-2.

23. No available data on existance of this slab.

24. Blow count method not used by soils engineer.

25. No floor drains in rooms 114 & 117. Floor drains in rooms 115, 116, & 119 shown on sheet A-8 Detail 11 and cross referenced.

26. No.

27. Cross reference added.

28. Not required by structural engineer.

29. Units shown are conc. masonry units not brick. Thru-wall flashing at base of solid masonry wall not required.

30. Completed and specified.

31. Vapor barrier or sealant not required, cross reference added.

32. Cannot use trade name - "Treated wood" is generic.

33. Fan is used to exhaust battery charger area.

34. Dock levelers are packaged units and will provide a minimum amount of manual operation but not very efficiently. Doors allow for manual opening and closing.

35. Connected load of 164 amps for PDP-1 does not justify 600 amps bus - MCC #1 will have 600 amp horiz. bus as standard.

36. Purpose of emergency lighting is to provide means of egress from building - amount shown is adequate.

37. See sheet E-2 they are on seperate panels.

38. Site lighting is from building mounted fixtures and evap. condenser area.

39. A/E stands by their recommendation.

40. A/E stands by their recommendation.

41. Corrected and completed.

42. Telephone service added - Public Address System not in scope of work.

43. Corrected and completed.

44. Deleted.

45. Lines to hydrant occur after line leaves vault.

46. A/E stands by their recommendation.

47. Electrical tie-in on sheet E-1, sewers are too high to use drains.

48. Has been put in specifications.

49. Two masks have been added.

50. Sheet M-1 dimensions come from only available existing data (Base Public Works).

51. Unless specific comments are made no changes are required.

ENGINEER-IN-CHARGE (DESIGN) RESPONSE to the CONSTRUCTABILITY REVIEW COMMENTS

The following is a list of the replies made to the review comments by the Government engineer responsible for the design stage. The item numbers refer to the comment numbers from the review.

1. Construction time increased to 450 days per ROICC request.

2. Wording is in accordance with NAVFAC instruction.

3. Corrected.

4. Demolition has been dropped - E. P. plan not required.

5. Same as no. 4 above.

6. Covered and completed.

7. Resolved in spec.

8. Corrected.

9. Drainage is via existing culvert per A/E recommendation.

10. See no. 9 above.

11. Not recommended - condensation trapped behind flashing.

12. Completed.

13. One in engine room.

14. 10 ton is correct - plans corrected.

15. Error in reproduction of spec.

16. Completed.

17. Completed 100 PSIG.

18. Corrected on plans - transformer not required.

19. Cannot mention Gamewell - item discussed with code 408 engineer.

20. Corrected and completed.

21. Added info to C-1.

22. Added info to C-2.

23. Slab is approx. 6 SF - covered under general removals.

24. Blow count method not used.

25. Floor drains are only in rooms 115, 116, & 119 - detail on A-8.

26. No. Clarified on roof plan - 1/2" slope with direction shown by arrow.

27. Corrected.

28. Not req'd by structural.

29. Units shown are CMU not brick - flashing thru-wall not req'd.

30. Completed and corrected.

31. Vapor barrier not req'd. - Detail added.

32. Cannot use trade name - "treated" is generic.

33. No. Only intermittent operation.

34. Dock levelers are packaged item. Manual operation only in emergency - Doors are auto/man operation.

35. No. Connected load is 164 amps - MCC #1 is only 600 amp bus.

36. Amount shown is adequate.

37. On seperate panel - see E-2.

38. Lighting from mounted fixtures.

39. No.

40. No.

41. Corrected.

42. Telephone added - P. A. not req'd.

43. Yes. Corrected.

44. Deleted. Transformer not req'd.

45. Lines connect after vault.

46. Flashing is req'd.

47. Elec tie-in on E-1. Sewers are too high for gravity drain.

48. Corrected.

49. Two masks have been added.

50. Corrected.

51. Review by Electrical Branch has been done. No electrical change orders anticipated.

DIRECT COST ANALYSIS

The following is an item by item analysis of those items from the constructability review noted to have direct cost implications.

Item-1 Construction time was increased from 270 to 450 days due to the long lead time on specific items as pointed out in this comment. Should this have been accomplished as a change order, the contractor could reasonably have requested additional compensation for his added overhead expenses (required by the contract) for this extended period. On a project of this size, field office rental, field personnel salaries, phone, electrical, etc. could be expected to be approximately $250.00 per day.

Overhead expense = 180 days x $250/day = $45,000.00

Item-6 This item adds equipment and labor costs to remove approximately 5 CY of rubble and 7.5 CY of poles, fencing, etc. Quantities are based on estimates by on-site personnel.

Equipment cost	=	5 CY rubble	@	$3.46/CY	=	$17.30
Equipment cost	=	7.5 CY poles	@	$4.38/CY	=	$32.85
Labor cost	=	5 CY rubble	@	$8.80/CY	=	$44.00
Labor cost	=	7.5 CY poles	@	$3.10/CY	=	$23.25

Item-8 By modifying the testing specification an minimum of three additional tests that might not have been required were added to the contract. The contractor could reasonably request relief for the cost of these tests. This cost will be considered an overhead expense.

Overhead cost	=	3 tests	@	$75 EA	=	$225.00

Item-13 This item adds labor and material costs required to procure and install one additional Ammonia Vapor Detector.

Material cost	=	1 unit	@	$110 EA	=	$110.00
Labor cost	=	1 unit	@	$27 EA	=	$27.00

Item-14 Where a 5 ton unit was indicated on the plans and a ten ton unit required, the government may have to reimburse the contractor for the difference in cost between the two units.

Material cost = $3325/10 ton - $1825/5 ton = $1500.00
Labor cost = $484/10 ton - $297/5 ton = $187.00

Item-30 Where material is required by the plan but no minimum quality has been specified, the contractor may reasonably expect to install the least expensive material. If this material does not meet the standards intended but not specified, then the contractor may request compensation for the difference in cost of the two materials.

Material cost = $.83/SF(spec) - $.57/SF(min) = $.26/SF
" " = 15,700 SF @ $.26/SF = $4,082.00

Labor cost = $.64/SF(spec) - $.47/SF(min) = $.17/SF
" " = 15,700 SF @ $.17/SF = $2,669.00

Item-41 This item adds labor and material costs to procure and install eight additional smoke detectors.

Material cost = 8 units @ $60 EA = $480.00
Labor cost = 8 units @ $27 EA = $216.00

Item-42 This item adds the labor and material costs to install outlets and stub-ups for a telephone system to be wired following completion of the construction phase by others.

Material cost = 5 outlets & covers @ $.96 EA = $4.80
Material cost = 40' of 3/4" conduit @ $.87 FT = $34.80
Labor cost = 5 outlets & covers @ $8.50 EA = $42.50
Labor cost = 40' of 3/4" conduit @ $1.88 FT = $75.20

Item-43 This item adds labor and material costs to procure and install three additional protection horns.

Material cost = 3 horns @ $20 EA = $60.00
Labor cost = 3 horns @ $25 EA = $75.00

Item-48 The cost for this item is covered in item No. 14.

Item-49 This item adds the material and labor costs to procure and install two gas masks and a storage cabinet for them.

Material cost	=	2 masks	@	$75 EA	=	$150.00
Material cost	=	1 cabinet	@	$115 EA	=	$115.00
Labor cost	=	1 cabinet	@	$7.40 EA	=	$7.40

DIRECT COST SUMMARY

Equipment Cost Totals	$ 50.15
Labor Cost Totals (incl. fringes, FICA, etc.)	$ 3,366.35
Material Cost Totals	$ 6,536.60
Field Overhead Expense (10%) [excluding items 1 & 8]	$ 995.31
Field Overhead Expense [items 1 & 8 only]	$45,225.00
Home Office Overhead (3%)	$ 1,685.20
Profit (6%)	$ 3,471.52
Bonding (assumed rate of .7%)	$ 429.31
TOTAL	$61,759.44

CALCULATION OF DIRECT COST BENEFIT

Assuming a 10% mark-up

$61,759.44
x .10

$ 6,175.94

Assuming a 2% mark-up

$61,759.44
x .02

$ 1,235.19

INDIRECT COST ANALYSIS

The following is an item by item analysis of those items from the constructability review having indirect cost implications. The analysis divides each item into two time componets: that of Lieutenant (O-3) and that of contract specialist (GS-5).

Item-1

(O-3)		(GS-5)	
Phone/conferences	45 min	Correspondence/filing	80 min
Correspondence	30 min	Miscellaneous Admin.	15 min
Negotiation	30 min		
Change Order admin	45 min		

Item-3

(O-3)		(GS-5)	
Phone/conferences	10 min	Correspondence/filing	20 min
Correspondence	15 min		

Item-6

(O-3)		(GS-5)	
Phone/conferences	15 min	Correspondence/filing	30 min
Correspondence	15 min	Miscellaneous admin	10 min
Negotiation	15 min		
Change Order admin	30 min		

Item-7

(O-3)		(GS-5)	
Pre-bid inquiries	30 min	Correspondence/filing	15 min
Correspondence	10 min		

Item-8

(O-3)		(GS-5)	
Phone/conferences	5 min	Correspondence/filing	30 min
Correspondence	10 min		
Negotiation	10 min		

Item-8 (cont.)

(O-3)	(GS-5)
Change Order admin ....20 min	

Item-13

(O-3)	(GS-5)
Phone/conferences ..... 5 min	Correspondence/filing .....30 min
Correspondence/Neg. ...15 min	
Change Order admin ....20 min	

Item-14

(O-3)	(GS-5)
Phone/conferences .....20 min	Correspondence .....30 min
Correspondence .....30 min	Filing .....20 min
Negotiation .....30 min	
Change Order admin ....30 min	

Item-15

(O-3)	(GS-5)
Pre-bid inquiries .....30 min	N/A

Item-16

(O-3)	(GS-5)
Pre-bid inqiries .....30 min	Correspondence/filing .....15 min
Correspondence .....10 min	

Item-17

(O-3)	(GS-5)
Phone/conference .....15 min	Correspondence/filing .....30 min
Correspondence .....20 min	

Item-18

(O-3)		(GS-5)	
Pre-bid inquiries	30 min	Correspondence/filing	15 min
Correspondence	15 min		

Item-21

(O-3)		(GS-5)	
Pre-bid inquiries	30 min	Correspondence/filing	20 min
Correspondence	15 min		

Item-22

(O-3)		(GS-5)	
Pre-bid inquiries	30 min	Correspondence/filing	20 min
Correspondence	15 min		

Item-23

(O-3)		(GS-5)	
Phone/conferences	30 min	Correspondence/filing	40 min
Correspondence	25 min		

Item-27

(O-3)		(GS-5)	
Phone/conferences	5 min	Correspondence/filing	5 min
Correspondence	5 min		

Item-30

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence	45 min
Research	30 min	Filing/ Misc admin	30 min
Correspondence	30 min		
Negotiation	30 min		
Change Order admin	30 min		

Item-31

(O-3)		(GS-5)	
Phone/conferences	5 min	Correspondence/filing	5 min
Correspondence	5 min		

Item-41

(O-3)		(GS-5)	
Phone/conferences	5 min	Correspondence/filing	30 min
Correspondence/Neg. ...	15 min		
Change Order admin	20 min		

Item-42

(O-3)		(GS-5)	
Phone/conferences	10 min	Correspondence/filing	30 min
Correspondence/Neg. ...	15 min		
Change Order admin	20 min		

Item-43

(O-3)		(GS-5)	
Phone/conferences	10 min	Correspondence/filing	30 min
Correspondence/Neg. ...	15 min		
Change Order admin	20 min		

Item-44

(O-3)		(GS-5)	
Pre-bid inquiries	30 min	Correspondence/filing	15 min
Correspondence	10 min		

Item-48

(This cost covered by item No. 14)

Item-49

(O-3)		(GS-5)	
Phone/conferences	10 min	Correspondence/filing	30 min

Item-49 (cont)

	(O-3)	(GS-5)
Correspondence/Neg.	15 min	
Change Order admin	20 min	

Item-50

	(O-3)	(GS-5)
Phone/conferences	10 min	Correspondence/filing 20 min
Verify Base Utilities	10 min	
Correspondence	15 min	
TOTAL TIME	1200 min (20 hrs)	660 min (11 hrs)
COST @	$12.32/hr	@ $7.51/hr
=	$ 246.40	= $ 82.61

TOTAL COST BENEFIT $ 329.01

COST OF PERFORMING THE REVIEW

		(O-3)		(GS-5)
TIME	=	18 hr	=	1 hr
COST	@	$12.32/hr	@	$7.51/hr
	=	$ 221.76		$ 7.51
		TOTAL COST		$ 229.27

CALCULATING RETURN ON INVESTMENT

Using a 10% cost mark-up		Using a 2% cost mark-up	
Direct Costs	$6,175.94	.....	$1,235.19
Indirect Costs	$ 329.01	.....	$ 329.01
TOTAL	$6,504.95		$1,564.20

$$\frac{\$6,504.95}{\$229.27} = 28.4 \qquad \frac{\$1,564.20}{\$229.27} = 6.8$$

CALCULATING CHANGE ORDER RATES

The following is a calculation of the Change Order Rate for the project, calculated as it actually occured on the project and as it would have existed had the original constructability review not been done.

Actual Change Order Rate

$$\frac{\$1,891,000.00}{\$1,849,000.00} = 102.3\% \quad \text{or} \quad 2.3\%$$

Change Order Rate Without Original Review

Using 10% mark-up

	$1,849,000.00	
−	$ 55,583.50	(90% D. Cost)
	$1,793,416.50	(Award Price)

Using 2% mark-up

	$1,849,000.00	
−	$ 60,524.25	(98% D. Cost)
	$1,788,475.75	(Award Price)

Change Order Total

	$ 61,759.44	(Est. Figure)
+	$ 42,000.00	(Act. Figure)
	$ 103,759.44	

Same as for 10% mark-up

Change Order Rate

	$1,793,416.50	
+	$ 103,759.44	
	$1,897,175.90	(Final Cost)

$$\frac{\$1,897,175.90}{\$1,793,416.50} = 5.78\%$$

	$1,788,475.75	
+	$ 103,759.44	
	$1,892,235.10	(Final Cost)

$$\frac{\$1,892,235.10}{\$1,788,475.70} = 5.80\%$$

SECOND CONSTRUCTABILITY REVIEW COMMENTS

1. Sheet C-1, General note: the dimension points on this sheet are somewhat different than those used by the various other disciplines. This may cause some confusion.
   [*** This item has indirect cost implications only. ***]

2. Sheet C-1, Dimension 15.00' between parking curb and the office (SW corner of the office) does not agree with the dimension on sheet A-1.
   [*** This item has indirect cost implications only. ***]

3. Sheet C-1, As the other existing underground utilities are shown, why are the existing high temperature water line and the hot water return lines omitted?
   [*** This item has indirect cost implications only. ***]

4. Sheet C-2, Elevation 98.26' (lower left corner of sheet) does not agree with the elevation shown on sheet T-1.
   [*** This item has indirect cost implications only. ***]

5. Sheet C-2, The two new power poles required by the contract should be identified.
   [*** This item has no cost implications. ***]

6. Sheet C-2, Same comment on the high temp. water & hot water return lines as on sheet C-1
   [*** This item has indirect cost implications only. ***]

7. Sheet A-1, Section 10/A-1/A-6 in room 102 does not fit the conditions existing very well.
   [*** This item has indirect cost implications only. ***]

8. Sheet A-2, The sum of the dimensions, 36'-0" and 6'-8" at the South East corner of the building does not agree with the dimensions, 20'-6", 20'-6", and 1'-2" shown on the North side of the building.
   [*** This item has indirect cost implications only. ***]

9. Sheet A-4, Detail 10 at the roof near grid 3, notes 19 and 20 both point to the same item. Note 19 is incorrectly used.
   [*** This item has indirect cost implications only. ***]

10. Sheet A-4, Detail 10, the thermal break near grid 3 at elevation 132'-9" is indicated, but no note was supplied. Should add note 46.
[*** This item has indirect cost implications only. ***]

11. Sheet A-4, Detail 8 at the foundation, Note 49 as indicated in all other conditions refers to only one anchor bolt. Suggest add "as indicated" after bolts on the note.
[*** This item has direct and indirect implications. ***]

12. Sheet A-5, Detail 12 at the foundation, shows a material between the foundation wall and the 10" insular panel and above the slab. What is it, how is it fastened etc.?
[*** This item has direct and indirect implications. ***]

13. Sheet A-5, Detail 10, insulation at the hanger rod indicates sealant at the top of the insulation but not at the bottom as shown elsewhere. Is this correct?
[*** This item has indirect cost implications only. ***]

14. Sheet A-5, Detail 7, insulation at the hanger rod does not indicate sealant. Is this correct?
[*** This item has indirect cost implications only. ***]

15. Sheet A-5, Detail 7, shows two mid-girts, however sheet S-3 shows that a C girt has only one mid-girt. Which is correct?
[*** This item has direct and indirect implications. ***]

16. Sheet A-5, Detail 7, shows the elevation of T/C8 girt as 131'-5" while detail 11/S3/S4 shows the elevation of this girt as 132'-7". Which is correct?
[*** This item has direct and indirect implications. ***]

17. Sheet A-6, Detail 10, this detail does not fit a section between rooms 102/103 very well.
[*** This item has indirect cost implications only. ***]

18. Sheet A-6, Note 49 does not include anchor bolts. Is this correct?
[*** This item has direct and indirect implications. ***]

19. Sheet A-6, Detail 7 at the foundation indicates a redwood spline, but does not call out note 46. Is this correct?
[*** This item has indirect cost implications only. ***]

20. Sheet A-8, Room 108 partition noted shows sound insulation on the inside of the partition on the East wall and the outside of the partition on the South wall. Is this correct?
[*** This item has indirect cost implications only. ***]

21. Sheet A-8, Room 111 partition noted shows sound insulation on the inside of the partition on the East wall and on the outside of the partition on the South wall. Is this correct?
[*** This item has indirect cost implications only. ***]

22. Sheet A-8, The symbol legend indicates the symbol for windows, but does not give sheet where the details are located.
[*** This item has no cost implications. ***]

23. Sheet A-8, Rooms 114 and 117 show what appear to be lockers, yet no details or specifications are provided. Should they have been? Are lockers to be provided by the contractor?
[*** Thie item has direct and indirect implications. ***]

24. Sheet A-10, Detail 26 is not called out on sheet A-1.
[*** This item has indirect cost implications only. ***]

25. Sheet S-2, Detail 14 is not called out on sheet S-1.
[*** This item has indirect cost implications only. ***]

26. Sheet S-3, Section 3/S4/S3 called out at the East side of the building does not exist. Suggest the detail should be 3/S3/S4.
[*** This item has indirect cost implications only. ***]

27. Sheet S-4, Detail 18 shows a single angle but refers to 12/S4/S4 which shows two angles. Which is correct?
[*** This item has direct and indirect implications. ***]

28. Sheet S-4, see comment regarding girt T/C8 on A-5 detail 7.
[*** This item has no cost implications. ***]

29. Sheet S-5, there are two details numbered 9.
[*** This item has indirect cost implications only. ***]

30. Sheet S-5, Detail 4 calls out detail 23/M1/M9 (upper right corner). There is no detail 23 on sheet M-9.
[*** This item has indirect cost implications only. ***]

31. Sheet M-2, There is no drain line shown for the sink in room 108.
[*** This item has indirect cost implications only. ***]

32. Sheet M-4, Units UC/6, UC/5, and UC/4 are shown as mounted 35'-0" A.F. The ceiling in room 106 is only 28'-0". Is this correct?
[*** This item has direct and indirect implications. ***]

33. Sheet M-5, the location of the risers (7/8" and 1 3/8") in room 108 does not agree with the location shown on sheet M-6.
[*** This item has direct and indirect implications. ***]

34. Sheet M-6, see note on sheet M-5.
[*** This item has no cost implications. ***]

35. Sheet M-8, Details 20 and 22 are not called out on sheet M-4.
[*** This item has indirect cost implications only. ***]

36. Sheet M-8, Detail 24 is not called out on sheet M-1.
[*** This item has indirect cost implications only. ***]

37. Sheet M-9, Detail 18 is not called out on sheet M-1.
[*** This item has indirect cost implications only. ***]

38. Sheet M-9, Detail 2, the sequence above H.P. FLR (in the middle of the detail) of the 4" branch, 4" H.D. 4" branch does not match the plan on sheet M-2. It should be 4" H.D., 4" branch, 4" branch.
[*** This item has no cost implications. ***]

39. Sheet E-7, all notes calling out details on sheet E-15 are incorrect.
[*** This item has indirect cost implications only. ***]

40. General note on electrical sheets; the roof unit for the office unit is not indicated on the electrical plans.
[*** This item has direct and indirect implications. ***]

41. General note on electrical sheets; the Ammonia Vapor Detectors are not indicated on the electrical diagrams.

[*** This item has direct and indirect implications. ***]

42. 15659-10 - Paragraph 2.9 specifies an ammonia vapor detector, but this is not shown on any drawing.
[*** This item has direct and indirect implications. ***]

SECOND CONSTRUCTABILITY REVIEW
DIRECT COST ANALYSIS

Item-11 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-12 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-15 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-16 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-18 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation required.

Item-23 Executed as a portion of Change Order P00002. Cost is $303.00.

Item-27 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-32 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-33 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

Item-40 Executed as a portion of Change Order P00003. Cost is $1,187.00.

Item-41 Executed as a portion of Change Order P00003. Cost is $368.00.

Item-42 Although this item does have direct cost implications, a review of the contract files indicates no additional compensation was required.

TOTAL DIRECT COST.....$1,858.00

CALCULATING DIRECT COST BENEFIT

Using a 10% mark-up

$1,858.00
x .10

$ 185.80

Using a 2% mark-up

$1,858.00
x .02

$ 37.16

SECOND CONSTRUCTABILITY REVIEW
INDIRECT COST ANALYSIS

The following is an item by item analysis of those items from the constructability review having indirect cost implications. The analysis divides each appropriate item into two time componets: that of Lieutenant (O-3) and that of Contract Specialist (GS-5).

Item-1 A review of the contract files indicates no correspondence regarding this item.

Item-2 A review of the contract files indicates no correspondence regarding this item.

Item-3 A review of the contract files indicates no correspondence regarding this item.

Item-4 A review of the contract files indicates no correspondence regarding this item.

Item-6 A review of the contract files indicates no correspondence regarding this item.

Item-7

(O-3)		(GS-5)	
Phone/conferences	15 min	Correspondence/filing	20 min
Correspondence	15 min		

Item-8

(O-3)		(GS-5)	
Phone/conferences	15 min	Correspondence/filing	20 min
Correspondence	15 min		

Item-9 A review of the contract files indicates no correspondence regarding this item.

Item-10 A review of the contract files indicates no correspondence regarding this item.

Item-11 A review of the contract files indicates no correspondence regarding this item.

Item-12 A review of the contract files indicates no correspondence regarding this item.

Item-13 A review of the contract files indicates no correspondence regarding this item.

Item-14 A review of the contract files indicates no correspondence regarding this item.

Item-15

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	30 min
Correspondence	30 min		

Item-16

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	30 min
Correspondence	30 min		

Item-17 Cost for this item was included in item No. 7.

Item-18 A review of the contract files indicates no correspondence regarding this item.

Item-19 A review of the contract files indicates no correspondence regarding this item.

Item-20

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	30 min
Correspondence	30 min		

Item-21 Cost for this item was included in item No. 20.

Item-23

(O-3)		(GS-5)	
Phone/conferences	30 min	Correspondence/filing	45 min
Correspondence	20 min		
Negotiation	20 min		
Change Order admin	30 min		

Item-24 A review of the contract files indicates no correspondence regarding this item.

Item-25 A review of the contract files indicates no correspondence regarding this item.

Item-26 A review of the contract files indicates no correspondence regarding this item.

Item-27 A review of the contract files indicates no correspondence regarding this item.

Item-29 A review of the contract files indicates no correspondence regarding this item.

Item-30

(O-3)		(GS-5)	
Phone/conferences	5 min	Correspondence/filing	10 min
Correspondence	10 min		

Item-31 A review of the contract files indicates no correspondence regarding this item.

Item-32

(O-3)		(GS-5)	
Phone/conferences	15 min	Correspondence/filing	20 min
Correspondence	20 min		

Item-33 A review of the contract files indicates no correspondence regarding this item.

Item-35 A review of the contract files indicates no correspondence regarding this item.

Item-36 A review of the contract files indicates no correspondence regarding this item.

Item-37 A review of the contract files indicates no correspondence regarding this item.

Item-39 A review of the contract files indicates no correspondence regarding this item.

Item-40

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	40 min
Correspondence	20 min		
Negotiation	15 min		
Change Order admin	20 min		

Item-41

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	30 min
Correspondence	15 min		
Negotiation	15 min		
Change Order admin	20 min		

Item-42

(O-3)		(GS-5)	
Phone/conferences	20 min	Correspondence/filing	30 min
Correspondence	30 min		

TOTAL TIME	555 min (9.25 hrs)			274 min (4.6 hrs)
COST	@ $12.32/hr		@	$7.51/hr
	= $ 113.96		=	$ 34.55

TOTAL INDIRECT COST BENEFIT ..... $ 148.51

COST OF PERFORMING THE REVIEW

		(O-3)		(GS-5)
TIME	=	9 1/2 hr	=	1/2 hr
COST	@	$12.32/hr	@	$7.51/hr
	=	$ 117.05	=	$ 3.75
TOTAL REVIEW COST				$ 120.80

CALCULATING RETURN ON INVESTMENT

Using a 10% mark-up

$$\begin{array}{r} \$185.80 \\ +\ \$148.51 \\ \hline \$334.31 \end{array}$$

$$\frac{\$334.31}{\$120.80} = 2.8$$

Using a 2% mark up

$$\begin{array}{r} \$\ 37.16 \\ +\ \$148.51 \\ \hline \$185.67 \end{array}$$

$$\frac{\$185.67}{\$120.80} = 1.5$$

GUIDELINES FOR OICC/ROICC PERSONNEL IN REVIEWING 90% & 100% PLANS & SPECIFICATIONS

I. Completion Times

A. Sufficient?

1. Long lead materials?

2. Unusual scheduling restraints?

3. Unusual construction requirements?

4. Seasonal constraints (i.e., roofing during rainy season, etc.)

5. Any materials specified which are unavailable?

II. Existing Conditions (Verify by Site Visit)

A. Properly indicated on the drawings?

1. Any visible structures/utilities/roads, etc. not shown?

2. Any known underground obstructions not shown?

3. Clearly defined responsibilities for Governement and contractor for relocation of any items?

4. Specifications clear on work in occupied spaces?

5. Disposition of existing items to be removed by the contractor adequately specified (Become the contractor's property or turned over to the OICC?)

III. Alternate Methods/Materials

A. Any methods specified which have proven to be more expensive/difficult than alternate method proven by experiences?

B. Any materials specified which are outdated in modern construction practice?

C. Any value engineering cost savings possible?

IV. Miscellaneous

A. Other construction contractors working in the same area?

1. Any conflicts anticipated?

2. Situation clearly described in specifications?

3. Responsibilities clear?

B. Government work (Public Works; contractors of other Navy or Government agencies) to be done in the same area?

1. Timing specified?

2. Responsibilities clear?

C. Availability of utilities during construction?

D. Acceptable working hours and procedure for overtime?

E. Storage space of material on site?

F. Procedure for scheduling outages?

G. Project sign or fence needed?

H. Inspector's office needed?

V. Administrative Items

A. Bid items

1. Should all be additive

2. Should not exceed more than four additivies

3. Should be non-cummulative, clearly define work and refer to drawings as applicable

B. Conformance with design criteria
Do the plans and specifications meet the requirements of the customer?

C. Liquidated damages

1. Should conform to the tables in P-68: 4-211

D. Quality control

1. All projects should include a section on quality control (see TS01400 or TS1401). TS-01101 for short form contracts includes a section for under $10,000.

E. Environmental protection

1. Most projects should include a section on environmental protection. Available as TS-01501 and must be tailored to the station and project.

F. Uniformity

1. Consistant use of the 16 Division breakdown of sections should be followed

2. All sections should be clearly identified

3. Table of contents to list Divisions but no further identification of these is necessary.

G. Applicable publications

1. This paragraph should appear first in all sections which use reference publications. It must list the correct title, applicable date and amendment data.

2. All documents listed must then be referenced to in the technical paragraphs.

H. Organization of technical requirements

1. Reference to quality control portion of Division 1 should be first

2. Submittal data should be next-samples, catalog cuts, etc.

3. Material requirements should be grouped next

4. Installation requirements follow

5. Field testing is last

I. Proprietary specifications

1. Not allowed without NAVFAC approval

2. Listing three trade names with "or equal" is okay as a last resort if no other means of specifying is satisfactory.

J. Repetition

1. Specify a subject completely in one place only. Don't repeat or split up a requirement in several sections.

K. Correlation between specifications and drawings

1. The same terms or words used to describe an item on the drawings should be used to describe the same item in the specifications. Be consistent

L. "Y" and type specifications

1. Must not be used as references in a project specification. "Y" specifications are obselete. Type specifications are only to be used as a guide for writing a project specification.

M. Government furnished material

1. Is to be listed in Section 01011

2. Is defined as material not previously existing at the job site but introduced by the Navy for use on a particular project.

3. The place and time of availability must be stated.

N. Salvage material

1. Is to be listed in Section 01011

2. Is defined as material coming from the job site which the government wishes to keep

3. The place for its storage must be stated

O. Government furnished utilities

1. If a charge is to be made, the rates must be stated.

2. Use of "at prevailing rates" is not permitted

P. Boiler plate clauses

1. Must be repeated, extracted from or modified by the project specification, without NAVFAC approval

Q. Schedule requirements

1. Does the specified schedule (i.e., CPM; bar chart) match the type of work being performed?

R. Submittals

1. Is responsibility for approval clearly indicated and have all appropriate items been identified for

submission?

S. Safety

1. Are construction methods specified which could result in accidents, or are work areas confined unnecessarily?

T. Shop drawings

1. Are the number of copies required specified?

U. Payment for material off-site

1. Include only if more advantageous to the government. The specifications must include the paragraph included in P-68: 6:303b

WESTNAVFACENGCOM

CONSTRUCTIBILITY CONTROL DOCUMENT

CONTRACT NUMBER

TLE AND LOCATION

A-E NAME			EIC (Name, Code & Tel. No.)
STATUS	DATE RECEIVED	DATE REVIEWED	REVIEWED BY (Name, Code & Tel. No.)
100%/FINAL			

REVIEW OF PLANS AND SPECIFICATIONS PRIOR TO BIDDING

	ITEM	YES	NO	N/A	REMARKS
BIDDING INFORMATION	1. Correct Bid Item wording and correct annotation on drawings				
	2. Multiple Bid Items correct?				
	3. Bidding place address correct?				
	4. Plan Issue Office address & telephone number correct?				
	5. Correct telephone number for bid inquiries				
	6. Pre-bid Site Visitation (Verify telephone number)				
GENERAL PARAGRAPHS	7. Adequacy of General Intention & General Description paragraphs				
	8. Adequate time for completion				
	9. Contract completion dates compatible with phasing/sequencing schedule?				
	10. Provision of liquidated damages for multiple completion dates specified?				
	11. Correct NAVFAC drawing numbers & titles in both specs & drawings?				
	12. Construction Cost Category Codes specified?				
	13. Salvage material & equipment requirements clearly specified?				
	14. Requirement for Construction Reps office				
	15. Site conditions verified?				
	16. Requirement for Network Analysis System				
	17. Special utility outage requirements				
	18. GFE/GFM requirements clearly specified?				
	19. Are restricted working areas & adequacy of working space reasonable?				
	20. Security requirements specified?				
	21. Special permits required?				
	22. DAR Clauses required for restricted data on computer/EMCS installations?				
	23. Requirement for CQC provisions (For projects over $2 Million)				
	24. Environmental Protection requirements				
SPECIFICATIONS AND DRAWINGS	Verify dimensions between Architectural, Structural, Electrical and Mechanical drawings				
	Cross check large scale plan I.D. Numbers with the Drawing Number where Plan/Section is drawn				
	Items specified "as indicated" or "where indicated" are in fact indicated on the drawings				
	Survey control monuments indicated?				
	Clearing and grubbing limits indicated?				
	Borrow and dump areas specified?				
	Estimated quantity of earthwork to be disposed identified and quantities shown on drawings				
	Landscaping system phasing & maintenance requirements				
	Irrigation system phasing required?				
	Availability of temporary utilities . Point of connections indicated?				
	Estimated pile lengths specified for bidding purposes?				
	Sheet Piling requirements clearly specified?				
	Adequate testing and sampling requirements				

REVIEW OF PLANS AND SPECIFICATIONS PRIOR TO BIDDING

	ITEM	YES	NO	N/A	REMARKS
SPECIFICATIONS & DRAWINGS CONT'D	Masonry building inspection requirements specified?				
	Verify ceiling heights at major duct intersection				
	Roof insulating materials storage requirements specified?				
	Roofing plans and specifications compatible?				
	Special roofing inspection and warranty required?				
	Door, window, light locations, etc. are consistent on all drawings				
	Verify keying requirements				
	Painting and Color Schedule requirements specified?				
	Adequate requirements for O & M Manuals and training of activity personnel				
	Requirements for start-up and turnover procedures of electrical and mechanical equipment				
	Verify adequacy of space provided for conduits, ductworks, electrical/mechanical/plumbing fixtures				
SPECIAL ITEMS	CHECK ADEQUACY OF PLANS AND SPECIFICATIONS FOR THE FOLLOWING CRITICAL ITEMS				
	Shoring requirements				
	Dewatering requirements				
	Test piles requirements				
	Asbestos Removal Procedure				
	Case Work				
	Kitchen Cabinets				
	Raised Floor Systems				
	Hardwares				
	Pre-Manufactured Buildings				
	Substations				
	Motor Control Centers				
	Medical and Dental Equipment				
	Elevators				
	Boilers				
	Refrigeration Units				
	Pumps				
	Heating and Air conditioning				
	Motor Controllers				
	Computer Installation				
	EMCS Requirements				
	RFI Shielding				

Other Comments/Remarks:

REFERENCES

1. Heery, G. T., Time, Cost, and Architecture, McGraw-Hill Book Co., New York, NY, 1975

2. Nigro, W. T., LCDR CEC USN, "REDICHECK Promises to Minimize Waste," Navy Civil Engineer, Vol. XXII, No. 4, Winter 83, pp 11-13

3. O'Brien, J. J., Value Analysis in Design and Construction, McGraw-Hill Book Co., New York, NY, 1976

4. Stone, P. A., Building Economy, Pergamon Press, New York, NY, 1976

5. _____, Building Construction Cost Data 1983, Robert Snow Means Company Inc., Kingston, MA, 1983

6. _____, Constructability Review Guidance, Western Division, Naval Facilities Engineering Command, 1983

7. _____, Construction Contract Administration and Management: Student Guide, U. S. Naval School, Civil Engineer Corps Officers, Port Hueneme, CA

8. _____, Construction Contract Modifications: Student Guide, U. S. Naval School, Civil Engineer Corps Officers, Port Hueneme, CA

9. _____, "Shedding Light on the Quality Control Problem," Building Design & Construction, Vol. 24, Sept. 1983, pg-15